

US EPA ARCHIVE DOCUMENT

# Columbia University

## Manhattanville in West Harlem

### Mixed Use Academic Development

## Successful Strategies for Diesel Emission Reduction in Non-Road Equipment

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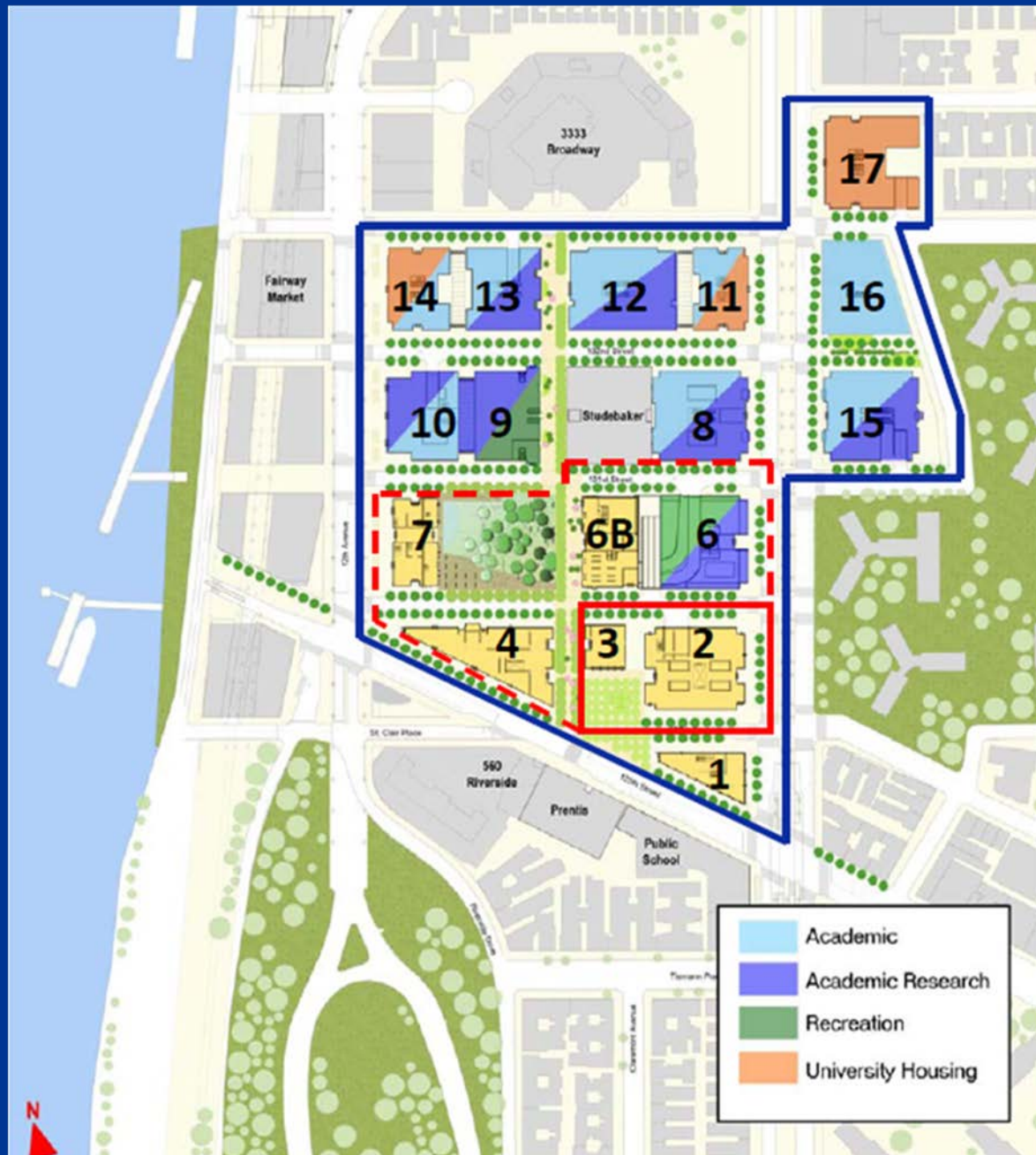


April 12, 2012  
EPA Region 5  
Midwest Clean Diesel Initiative

# Agenda

- 1) Diesel Pollution – a problem for health and climate
- 2) Construction equipment's contribution to the problem
- 3) Solution – technology and commitment
- 4) Clean diesel construction an opportunity
- 5) Deploying clean diesel

# Agenda





# Agenda





# Agenda



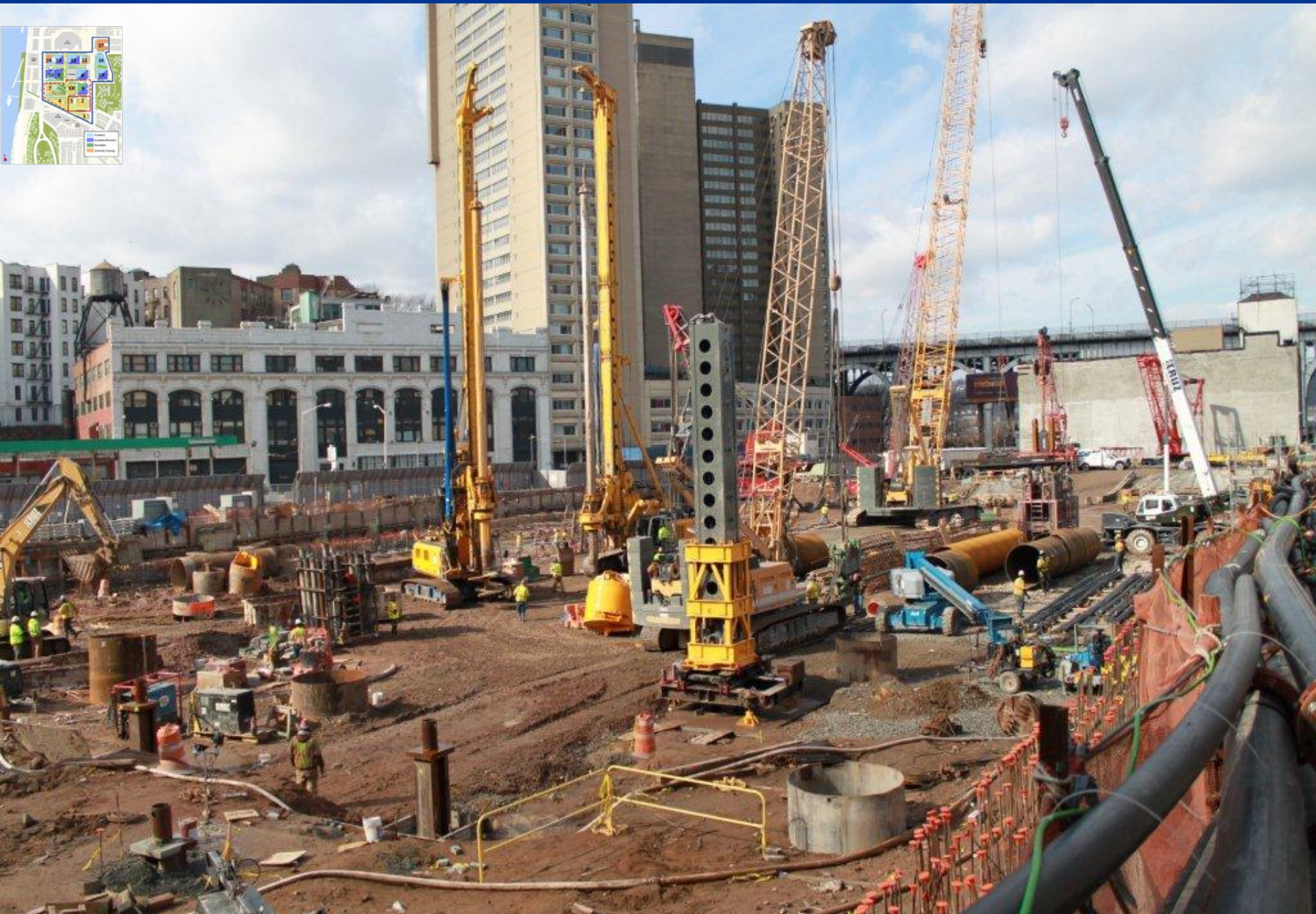


# Agenda





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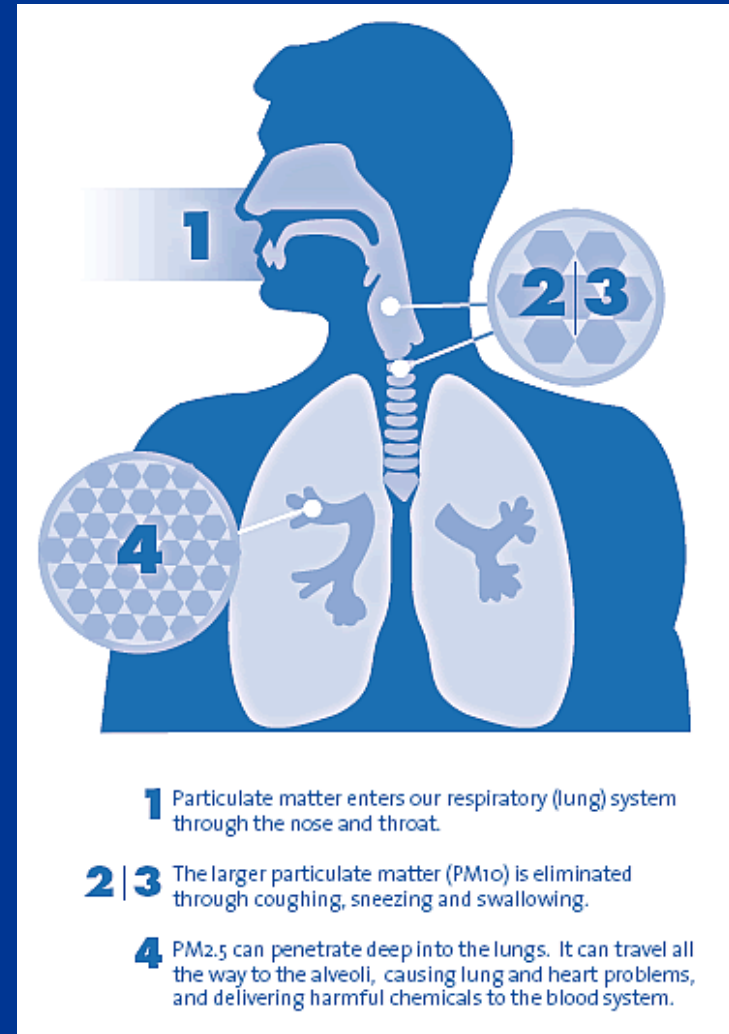


# Agenda



# How Diesel Exhaust Hurts Us

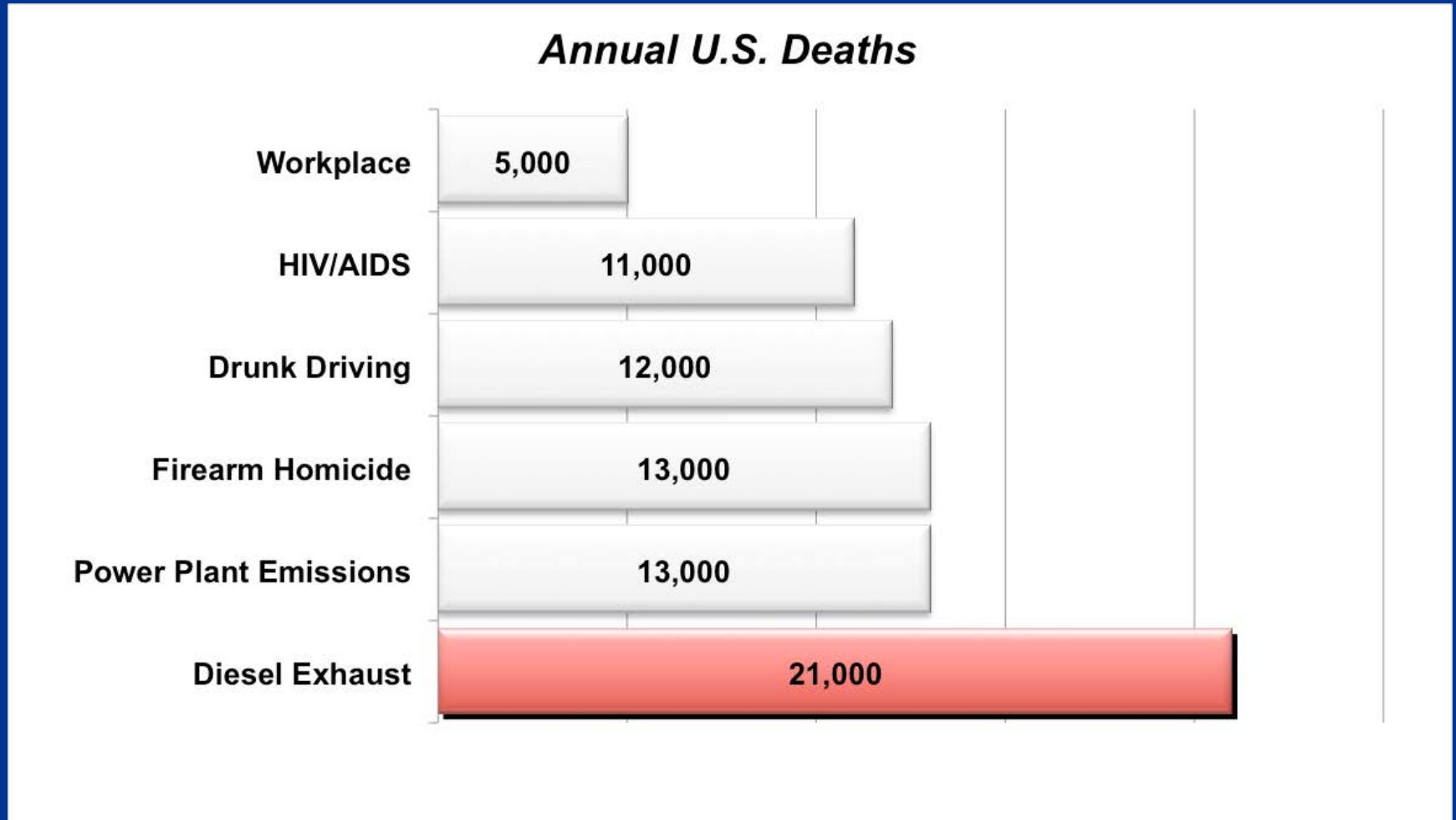
- 1) Toxics attach to the outside of tiny diesel particles, which are small enough to invade the lungs, enter the bloodstream & trigger cardiovascular disease (heart attacks, stroke), and travel to other human organs
- 2) Emitted at **ground level where people breathe**, diesel exhaust is inhaled during daily life
- 3) There is **no safe level of particulate matter** exposure, according to the HEI (Health Effects Institute) National Morbidity and Mortality Particulate Matter Study (2004)
- 4) The good news: Mortality is reduced when particles are reduced (Harvard Six Cities Study, 2006)



Source: Clean Air Task Force (CATF)



# 21,000 Deaths A Year - High Risk Of Mortality From Diesel Exhaust



**Sources: (slide from CATF)**

Power plant and diesel exhaust mortality: Clean Air Task Force at: (<http://www.catf.us>)

NHTCA 2009. Traffic Safety Annual Assessment (2008 data) at: <http://www-nrd.nhtsa.dot.gov/Pubs/811172.pdf>

CDC May 2010 (2007 data), National Vital Statistics Report at [http://www.cdc.gov/NCHS/data/nvsr/nvsr58/nvsr58\\_19.pdf](http://www.cdc.gov/NCHS/data/nvsr/nvsr58/nvsr58_19.pdf)

# Diesel Black Carbon - A Potent Global Warming Agent

**POTENT** -- As a warming pollutant, black carbon is about **2000** times more potent than the equivalent amount of CO<sub>2</sub> over a 20yr period.

- **FROM DIESELS** – U.S. highest per capita emitter. **Over half** (57%) of U.S. black carbon comes from diesels.

- **MEETS IMMEDIATE NEED** – **Immediate** climate benefits of BC reductions are possible due to its short atmospheric lifetime (days to weeks).

- **CLIMATE CO-BENEFIT** – Reducing maximum PM in diesel exhaust for health also achieves a climate benefit.



*Like an asphalt road, black carbon soot absorbs sunlight and heats up the atmosphere*



# DPF Virtually Eliminates PM and BC

Photos compare PM emissions before and after the installation of a diesel particulate filter (DPF) retrofit.



*PM emissions before retrofit*



*After retrofit*

# DRIVING FORCES

1) Doing the right thing. Do “IT” right & Do the right “IT”



1) Environmental Impact Statement (EIS)

a. Record of Decision (RD)

b. Restrictive Declaration (RD)

2) Community Board (CB)

3) State – cannot preempt, however ...

4) City – cannot preempt, however ...

5) Company Policy



1) Contract Specifications



# RESTRAINING FORCES

- |   |  |
|---|--|
| 1) Cost to project  | find money   |
| 2) Safety (line of sight)                                 | solutions are available that do not interfere with line of sight |
| 3) All the reasons why it cannot be done or will not work | DPF has been installed on many machines                          |

- 
- 1) Not restraining forces as these are economic choices (emissions is not the driver, age & value is)
- a. Replace machine
  - b. Repower with new engine
  - c. Remanufacture / Rebuild old engine
  - d. Repair engine

# Drill – Comacchio MC602



2010 engine, 96 HP, tier 3, DPF



# Crane – Manitowoc 2250



2008 engine, 500 HP, tier 3, DPF



# Compressor - IR XP375



**ECRUZ**

15

**ECRUZ**  
HEAVY CONSTRUCTION



2005 engine, 125 HP, tier 2, DPF



# Drill – Conti HD110



2009 engine, 156 HP, tier 3, DPF



# Loader – CAT 966H



2006 engine, 261 HP, tier 3, DPF is inside engine compartment



# Loader Backhoe – CAT 450E



2008 engine, 137 HP, tier 2, DPF muffler replacement



# Excavator – CAT 345C



2006 engine, 388 HP, tier 3, DPF inside engine compartment



# Crane - Liebherr HS885

## Power Pack

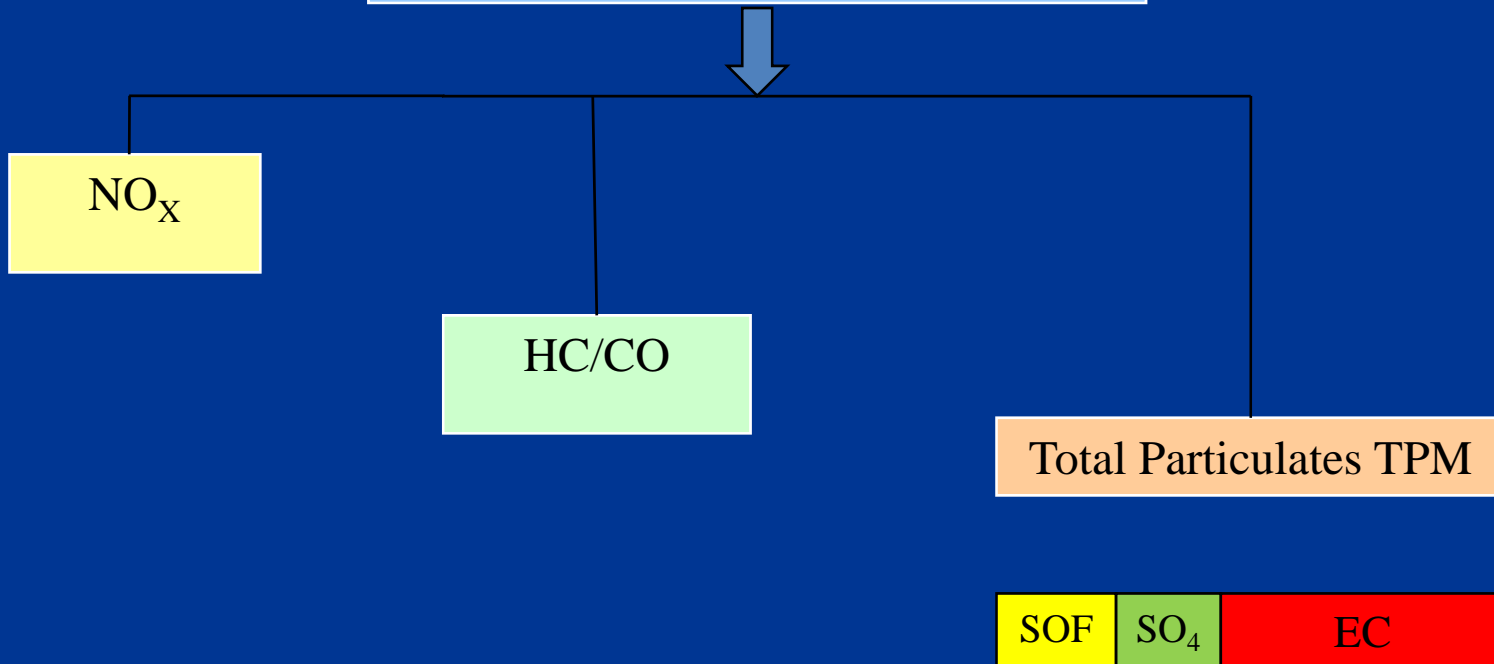
2007 engine, 700 HP, tier 3, DPF



2008 engine, 911 HP, tier 2, DPF

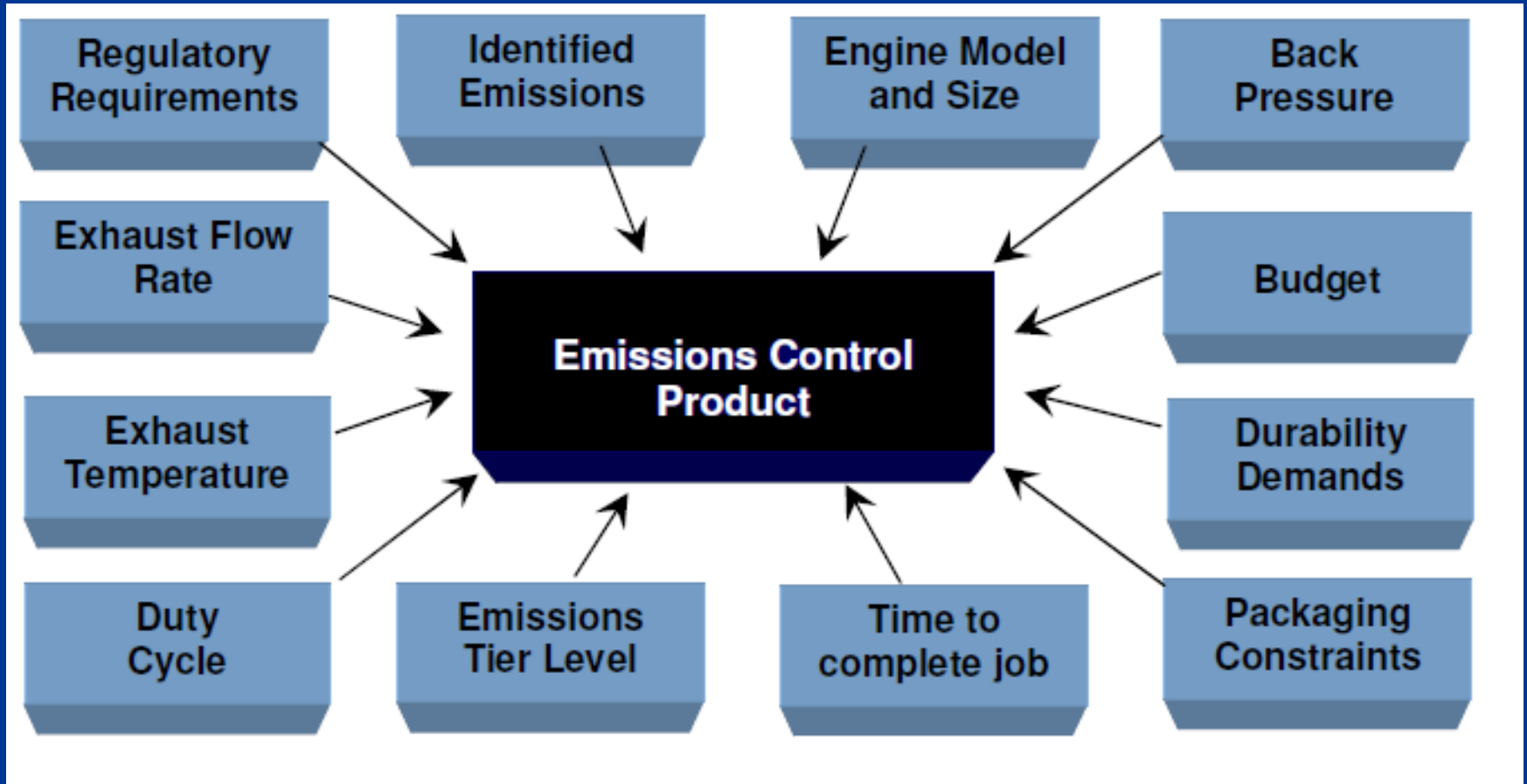
# Diesel Exhaust

## Diesel Exhaust Emissions

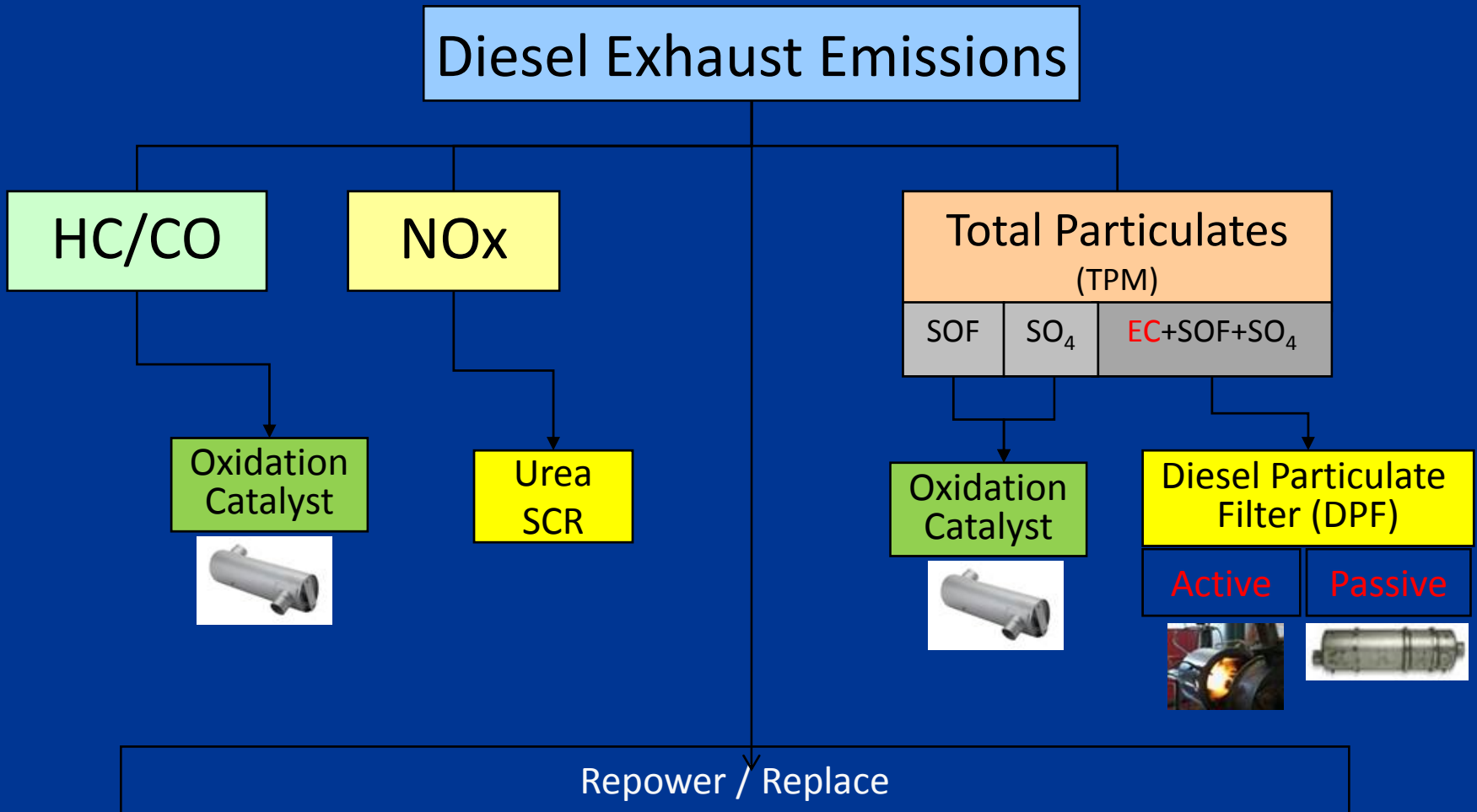




# Variables That Impact Decision Making



# Emission & Retrofit Match





# Emissions Reduction Options

## PM CONTROL

Diesel Oxidation  
Catalyst (DOC)

Flow Through Filter  
(FTF)

Passive Diesel  
Particulate Filter  
(P-DPF)

Active Diesel  
Particulate Filter  
(A-DPF)

## NO<sub>x</sub> Control

Exhaust Gas  
Recirculation (EGR)

NO<sub>x</sub> Reducing  
Catalyst (NRC)

Selective Catalytic  
Reduction (SCR)

## RETROFIT DEVICES

## Alternative Fuels

BioDiesel

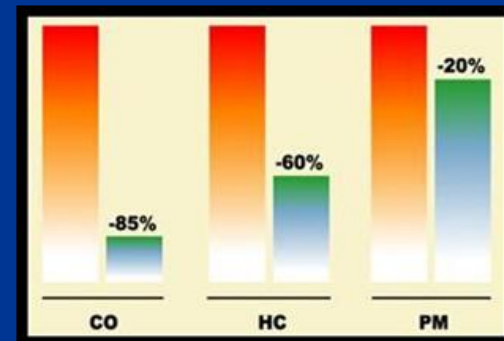
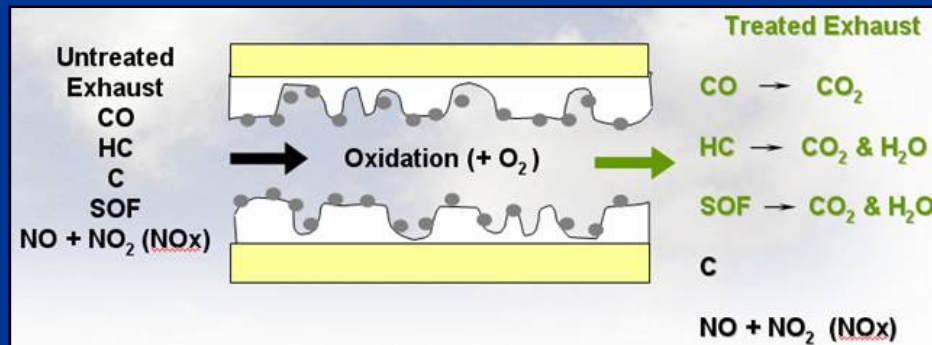
Oxygenated Diesel

Fuel Borne  
Catalyst

Emulsified Diesel

# Diesel Oxidation Catalyst (DOC)

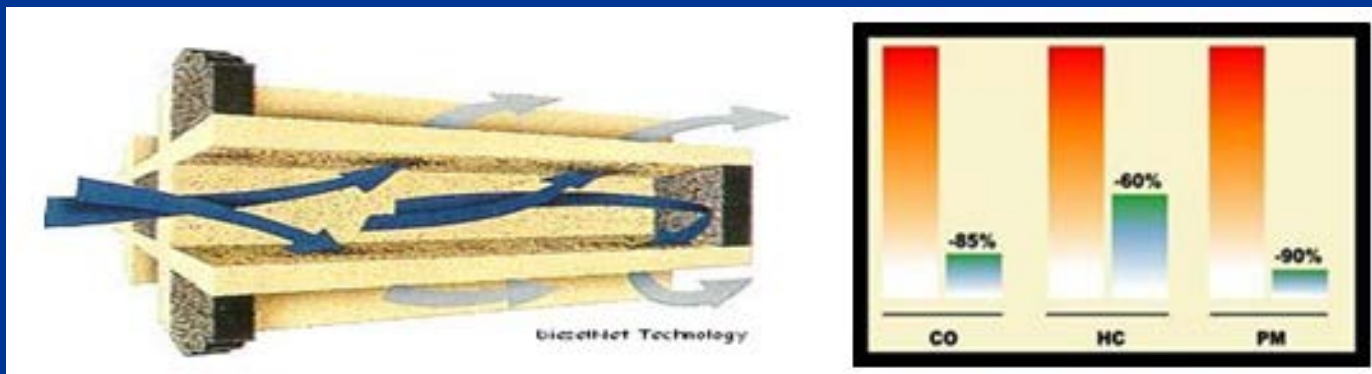
- Reduces PM attributable to SOF
- Very efficient at reducing HC, CO
- Does not reduce NOx
- Flow through design
- Can be a muffler replacement
- Maintains engine life and performance
- Optimum reductions with ULSD fuel
- Limited verified product





# Passive Diesel Particulate Filter (DPF)

- Very efficient at reducing PM
- Reduces HC and CO
- Passive regeneration dependant on load
- Catalyze and non-catalyzed versions
- ULSD required (and Tier 1 or cleaner)
- Requires monitoring system
- Maintenance potential
- Significantly heavier than mufflers
- Operators visibility should be considered
- EPA and CARB Verified filters available



# Choosing Vehicles to Retrofit - Off Road Retrofit Strategies

## Pre-1996 engines (unregulated)

### Engine (tier 1) Upgrade or Replacement

- Cost effective NOx and PM
- Enabler for passive DPFs

and



- Apply DPF regionally
- Significant PM reductions
- Achieve near Tier 4 PM levels

## Post-1996 & 1997 (Tier 1 & 2 and some Tier 3)

### Passive Diesel Particulate Filter

- Cost effective PM reductions
- Investigate NOx/PM ratio before committing to passive DPF

## Machines without adequate exhaust temp or low NOx/PM and HIGH machine value

### Active Diesel Particulate Filter

- Higher implementation cost and potential operational costs
- High PM reductions
- Functional with low exhaust temperature applications

## Machines without adequate exhaust temp or low NOx/PM and LOW machine value

### Replace Machine

- NOx and PM reductions through machine replacement





# Summary of Emission Options

	Option	PM	NOx
Retrofit Technology	DOC	25+%	No Effect
	FTF (HP-DOC)	50+%	No Effect
	DPF (Active or Passive)	85+%	No Effect
	NOx Reducing Catalyst	No Effect	25 – 35%
	SCR	10 – 25%	70 - 90%
Fuel Options	Emulsified Diesel	17 - 23%	9 - 20%
	Biodiesel	0 – 20%	0 - +10%
	Oxy-Diesel	10 - 20%	0 - +10%
	Fuel Borne Catalyst	0 – 15%	0 – 5%

# Clean Diesel Spec Development

## NON-ROAD EQUIPMENT

1

Use of ULSD fuel in all diesel engines

2

Use of Tier 2 or 3 certified engines in all non-road equipment  $\geq 50$  hp

3

Use of EPA/CARB/verified DPF and back pressure monitor in construction equipment with engines  $\geq 50$  hp \*

Contract Specifications

\*Substantiate where technically not feasible.



# Clean Diesel Spec Development

## ON-ROAD FLEET

1

Use of ULSD fuel in all diesel engines

2

Use of on road equipment fleet with engine certified at 0.01g/hp-hr for PM

3

On-road fleet applies to: concrete delivery trucks, concrete pumping trucks, soil delivery/disposal dump trucks

Contract Specifications

# Discussion



**Columbia University  
Manhattanville in West Harlem  
Mixed Use Academic Development**